

PREY AND TROPHIC ECOLOGY OF GREAT HORNED OWLS
IN WESTERN SOUTH AMERICA:
AN INDICATION OF LATITUDINAL TRENDS

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ABSTRACT—Quantitative information on the diet of three Great Horned Owl (*Bubo virginianus*) populations along 18 lat. degrees in western South America (Chile) is compared with that of Great Horned Owls in comparable latitudes along western North America. In Chile, owls preyed mainly on small mammals, with proportion of birds decreasing, and that of insects increasing, toward southern latitudes. Mean prey size and diet breadth declined toward southern Chile. These latitudinal trends closely mirror those documented in western North America.

Although the Great Horned Owl (*Bubo virginianus*) is distributed throughout the Americas, its food habits have received considerable study mainly in North America (Burton 1973). The only published quantitative information on their food habits in South America comes from central Chile (approximately latitude 33° to 38°; see Jaksic and Yáñez 1980; Jaksic and Marti 1984). Except for a preliminary report by Jaksic et al. (1978), no dietary information was previously available from their southernmost distribution (see Humphrey et al. 1970). Here we report the prey identified in 125 fresh pellets collected in September (austral spring) 1977 and in 14 other pellets collected in July (winter) 1978, from under the same nest located at Torres del Paine National Park (approximately 51° 01' S, 72° 54' W; 142 km north of Puerto Natales). For purposes of comparison we report earlier dietary data published by Reise and Venegas (1974) in a Chilean journal of very local circulation. Their study material (an unreported number of fresh pellets, ± 55) was collected under one nest, located 10 km north of Puerto Ingeniero Ibáñez (46° 18' S; 71° 55' W), in January (summer) 1971. For comparative purposes we also use Jaksic and Yáñez's (1980) report on the prey of the Great Horned Owl at La Dehesa (33° 21' S, 70° 32' W; 20 km east of Santiago), based on 98 fresh pellets collected during September (spring) 1979, beneath one nest. Although the information analyzed is based on very small sample sizes, we believe it is useful in consolidating new and old information fragmented in the Chilean literature and not readily available to ornithologists elsewhere.

METHODS

Considering that ca. 95% of the pellets analyzed reflect spring and summer diet, and that this dietary information covers approximately 18° latitude, a quantitative comparison seems warranted. We use the following trophic metrics: (a) Geometric mean prey weight in the diet — essentially the back-transformation of the mean prey size obtained with log-transformed weight data, weighted by their relative occurrence in the diet (see Jaksic and Braker 1983 for formula, justification, and assumptions of this trophic statistic). Prey sizes are mean weights of small mammals in Table 1. (b) Diet breadth — the diversity of prey in the diet as computed by Levins' (1968) index: $B_{obs} = 1/(\sum p_i^2)$, where p_i is the relative occurrence of prey taxon i in a given population's diet. This index generates values between 1 and n (when n resources are used equally). Because Levins' index increases with the number of prey taxa, a standardization is necessary when comparing populations in different localities, where the availability of prey taxa may differ. Colwell and Futuyma (1971) provide a standardized version of Levins' index: $B_{sta} = (B_{obs} - B_{min})/(B_{max} - B_{min})$, where B_{obs} is the observed niche breadth (= Levins' index), B_{min} is the minimum niche breadth possible (= 1), and B_{max} is the maximum niche breadth possible (= n), which is the number of prey taxa actually taken by a given owl population (i.e., each of the taxa that receives a separate line in Table 1; generally, species for mammals and orders for insects). This standardized index renders values between 0 and 1 (i.e., between a comparatively narrow niche breadth, with disproportionately high representation of one or a few prey items, and a broad one, with a more even consumption of the available prey categories, respectively).

RESULTS AND DISCUSSION

Results are summarized in Table 1, and are here discussed in a north-south succession. In La Dehesa, the owls preyed upon all small mammals known to occur in the locality (see Jaksic et al. 1981), with the exception of the rodents *Octodon degus* (a semi-fossorial species) and *Spalacopus cyanus* (a truly fossorial one). Jaksic and Yáñez (1980)

Table 1. Prey of Great Horned Owls in La Dehesa (33° S), Puerto Ibáñez (46° S), and Torres del Paine (51° S), Chile. Figures are percentages by number of prey individuals; subtotals are in brackets.

| PREY CATEGORIES | WEIGHT(g)* | 33°S | 46°S | 51°S |
|---|------------|--------|--------|--------|
| MAMMALIA | | [88.6] | [86.0] | [87.5] |
| Lagomorpha | | | | |
| <i>Lepus capensis</i> | 2,000.0 | — | 5.3 | 0.6 |
| <i>Oryctolagus cuniculus</i> | 1,300.0 | 15.8 | — | — |
| MARSUPIALIA | | | | |
| <i>Marmosa elegans</i> | 40.0 | 3.5 | — | — |
| RODENTIA | | | | |
| <i>Abrocoma bennetti</i> | 219.0 | 18.4 | — | — |
| <i>Akodon lanosus</i> | 32.5 | — | — | 4.8 |
| <i>Akodon longipilis</i> | 76/41.0** | 16.7 | 8.7 | 3.0 |
| <i>Akodon olivaceus</i> | 40.0 | 0.8 | — | — |
| <i>Akodon xanthorhinus</i> | 21.5 | — | 5.3 | 9.5 |
| <i>Ctenomys cf. magellanicus</i> | 271.8 | — | 15.8 | — |
| <i>Eligmodontia typus</i> | 26.5*** | — | — | 0.6 |
| <i>Euneomys chinchilloides</i> | 87.8*** | — | 26.3 | 0.6 |
| <i>Notiomys macronyx</i> | — | — | — | 2.4 |
| <i>Oryzomys longicaudatus</i> | 45/29.8** | 4.4 | 1.8 | 39.8 |
| <i>Phyllotis darwini</i> | 66.0 | 4.4 | 7.0 | — |
| <i>Phyllotis micropus</i> | 75.0 | — | 12.3 | — |
| <i>Phyllotis</i> sp. | — | — | 3.5 | — |
| <i>Rattus rattus</i> | 158.0 | 19.3 | — | — |
| <i>Reithrodon physodes</i> | 81.7 | — | — | 25.6 |
| Unidentified | — | 5.3 | — | 0.6 |
| AVES | | [11.4] | [5.3] | [2.4] |
| Unidentified | — | 11.4 | 5.3 | 2.4 |
| INSECTA | | [0.0] | [8.7] | [10.1] |
| Coleoptera | — | — | 8.7 | 8.9 |
| Hymenoptera | — | — | — | 0.6 |
| Orthoptera | — | — | — | — |
| Unidentified | — | — | — | 0.6 |
| No. pellets | | 98.00 | 55? | 139.00 |
| No. prey | | 114.00 | 57.00 | 168.00 |
| Geometric mean prey weight (g) | | 181.9 | 104.5 | 41.1 |
| Twice standard error | | 0.61 | 0.83 | 0.31 |
| Sample size (= prey with weight) | | 95.00 | 47.00 | 142.00 |
| Diet breadth (<i>Bobs</i>) | | 6.90 | 7.18 | 4.07 |
| Standardized diet breadth (<i>Bsta</i>) | | 0.66 | 0.62 | 0.24 |

*Weights with no decimal places are from Jaksic and Marti (1984); all the remaining (except for those marked with asterisks) are from Jaksic et al. (1983).

**There is a strong latitudinal cline in body size for this species (see Yáñez et al. 1978, and Palacios 1982): the first figure corresponds to its mean weight in central Chile; the second, to its mean in southern Chile.

***From Greer (1965).

suggested that the absence of these 2 species from the Great Horned Owl diet was due to their diurnal-crepuscular activity pattern. In Puerto Ibáñez, owls preyed on essentially all small mammal species trapped by Reise and Venegas (1974) in the same locality, and on 2 additional rodents: *Euneomys chinchilloides* (a scansorial species) and *Ctenomys* cf. *magellanicus* (a fossorial one). These 2 made up more than 40% of the owls' diet (Table 1), but were neither trapped nor seen in the area (Reise and Venegas 1974; Yáñez et al. in press). In Torres del Paine, owls preyed on all small mammal species known to occur there, as well as on 3 other rodents hitherto not recorded (Rau et al. 1978): the terrestrial *Eligmodontia typus* and *Akodon lanosus*, and the semi-fossorial *Notiomys macronyx*. In general, the three owl populations studied preyed mainly on small mammals (averaging 87% of their prey). With increasing latitude, the proportion of birds in the diet decreased, with the opposite trend seen in the insect prey (from no insect consumption at all in La Dehesa, to 10% of the diet in Torres del Paine).

The geometric mean weight of prey declined monotonically from north to south, with no indication of a corresponding trend in owl body size (Johnson 1965; Humphrey et al. 1970). A similar (but not so consistent) decline in mean prey weight away from the equator was reported by Knight and Jackman (1984) for Great Horned Owls along the Pacific coast of the United States. Comparing areas at latitudes 30° to 40° between the two hemispheres, Jaksic and Marti (1984) showed that central Chilean and California Great Horned Owls did not differ significantly in body size (1,227 g vs. 1,166 g, respectively), but mean prey weight of California owls was 59% of Chilean ones. Knight and Jackman (1984) reported mean prey weight of Great Horned Owls in central Washington (46° N), which coincides with the latitude of Puerto Ibáñez. Because Knight and Jackman (1984) used an arithmetic estimate of mean prey weight, we recalculated from their raw data the geometric estimate, thus making their results comparable to ours. Washington owls exhibited a geometric mean prey weight of 22.9 ± 0.21 g (mean \pm 2 s.e.; sample size = 872) which amounted to only 22% of the value reported for southern Chilean owls at the equivalent latitude (Table 1). It is difficult to assign causal relations to these patterns without knowing prey sizes available to owls in these different localities. Knight and Jackman (1985), following Herrera and Hiraldo

(1976), speculated that the decrease in mean prey weight taken by owls at higher latitudes may be related to smaller prey becoming more abundant as latitude increases. We have no data to substantiate this claim.

Diet breadth in Chile also decreased with increasing latitude, in agreement with trends reported by Knight and Jackman (1984) for the Great Horned Owl along the Pacific coast of the United States and by Herrera and Hiraldo (1976) for the Eagle Owl (*Bubo bubo*) in Europe. Jaksic and Marti (1984) reported that central Chilean and California Great Horned Owls have a similar diet breadth at the class level of prey identification (H'NMG in their Table 3), but that the former have significantly narrower diet breadth at the species level of mammalian prey H'NM in their Table 3). Knight and Jackman (1984) documented a diet breadth of 4.12 (which amounts to a standardized diet breadth = 0.12; because $B_{max} = 26$, and $B_{min} = 1$) for Washington Great Horned Owls. These values amount to 57% and 19% (respectively) of those computed for owls at the equivalent latitude in Chile, and are in fact more similar to observations 5 latitudinal degrees south, in Torres del Paine (Table 1). Apparently, both South and North American Great Horned Owls exhibit narrower diets toward higher latitudes, but the latter prey heavily on relatively few items. In fact, only two rodents (*Thomomys talpoides* and *Perognathus parvus*) accounted for 73% of the items in the diet of Washington owls. A similar value in the diet of Chilean owls was accounted for by the six most preyed upon rodent species in Puerto Ibáñez, and by three in Torres del Paine (Table 1). The decreasing diet diversity away from the equator might be related to a decreasing number of potential prey species which is consistent in both hemispheres.

Latitudinal trends in the trophic niche of Great Horned Owls along the Pacific coast of southern South America closely mirror trends documented in northern North America (and of the congeneric Eagle Owl in Europe). Local estimates of trophic statistics for latitudinally-matched localities in the two hemispheres, however, show some marked differences. The pattern of decreasing diet diversity away from the equator could have been expected, but a similar trend in mean prey weights at corresponding latitudes, both related to the local availability/vulnerability of prey, was unlikely to hold within/between the two hemispheres.

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LITERATURE CITED

- BURTON, J.A. [ed.]. *Owls of the World*, E.P. Dutton, New York.
- COLWELL, R.K., AND D.J. FUTUYMA. 1971. On the measurement of niche breadth and overlap. *Ecology* 52:567-576.
- GREER, J.K. 1965. Mammals of Malleco province, Chile. *Publ. Mus., Michigan State Univ., Biol. Ser.* 3:49-152.
- HERRERA, C.M., AND F. HIRALDO. 1976. Food-niche and trophic relationships among European owls. *Ornis Scand.* 7:29-41.
- HUMPHREY, P.S., D. BRIDGE, P.W. REYNOLDS, AND R.T. PETERSON. 1970. *Birds of Isla Grande (Tierra del Fuego)*. Preliminary Smithsonian Manual, Smithsonian Institution, Washington, D.C.
- JAKSIĆ, F.M. AND H.E. BRAKER. 1983. Food-niche relationships and guild structure of diurnal birds of prey: competition versus opportunism. *Can. J. Zool.* 61:2230-2241.
- JAKSIĆ, AND J. L. YÁÑEZ. 1980. Differential utilization of prey resources by Great Horned Owls and Barn Owls in central Chile. *Auk* 97:895-896.
- JAKSIĆ, F.M., H.W. GREENE, AND J.L. YÁÑEZ. 1981. The guild structure of a community of predatory vertebrates in central Chile. *Oecologia* 49:21-28.
- JAKSIĆ, F.M., J. RAU, AND J. YÁÑEZ. 1978. Oferta de presas y predación por *Bubo virginianus* (Strigidae) en el Parque Nacional "Torres del Paine." *anales del Instituto de la Patagonia, Punta Arenas (Chile)* 9:199-202.
- JAKSIĆ, F.M., AND C.D. MARTI. 1984. Comparative food-habits of *Bubo* owls in Mediterranean-type ecosystems. *Condor* 86:288-296.
- JAKSIĆ F.M., J.L. YÁÑEZ, AND J.R. RAU. 1983. Trophic relations of the southernmost populations of *Duscycyon* in Chile. *J. Mamm.* 64:693-697.
- JOHNSON, A.W., 1965. *The birds of Chile and adjacent regions of Argentina, Bolivia and Peru: volume II*. Platt Establecimientos Gráficos, Buenos Aires.
- KNIGHT, R.L., AND R.E. JACKMAN. 1984. Food-niche relationships between Great Horned Owls and Common Barn-Owls in eastern Washington. *Auk* 101:175-179.
- LEVINS, R. 1968. *Evolution in changing environments: some theoretical explorations*. Princeton Univ. Press, Princeton, New Jersey.
- PALACIOS, O.V. 1982. *Morfometría y sistemática de Oryzomys longicaudatus* (Rodentia: Cricetidae). Thesis, Universidad de Chile, Santiago, 91 pp.
- RAU, J., J. YÁÑEZ AND F. JAKSIĆ. 1978. Confirmación de *Notiomys macronyx alleni* O. y *Eligmodontia typus typus* C., y primer registro de *Akodon (Abrothrix) lanosus* T. (Rodentia: Cricetidae) en la zona de Última Esperanza (XII Región, Magallanes). *Anales del Instituto de la Patagonia, Punta Arenas (Chile)* 9:203-204.
- REISE, D., AND W. VENEGAS. 1974. Observaciones sobre el comportamiento de la fauna de micromamíferos en la región de Puerto Ibáñez (Lago General Carrera), Aysén, Chile. *Boletín de la Sociedad de biología de Concepción (Chile)* 47:71-85.
- YÁÑEZ, J., W. SIELFELD, J. VALENCIA, AND F. JAKSIĆ. 1978. Relaciones entre la sistemática y la morfometría del subgénero *Abrothrix* (Rodentia: Cricetidae) en Chile. *Anales del Instituto de la Patagonia, Punta Arenas (Chile)* 9:185-197.
- YÁÑEZ, J.L., J.C. TORRES-MURA, J.R. RAU, AND L.C. CONTRERAS. In press. New record and current status of *Euneomys* (Cricetidae) in southern South America. *Fieldiana (Zoology)*.

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